the threatened spring-run chinook salmon and to restore these stocks to levels that will allow their removal from the list of endangered species.

- Salmon, Steelhead Trout and Anadromous Fisheries Program Act: The California Department of Fish and Game (DFG) is required under State legislation (the Salmon, Steelhead Trout and Anadromous Fisheries Program Act of 1988) to double the numbers of salmon that were present in the Central Valley in 1988 (Reynolds et al. 1993).
- California Endangered Species Act which can provide specific criteria for down listing, delisting, and recovery of listed species.

LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

Chinook salmon are closely dependent on ecological processes and habitats and adversely affected by a variety of stressors.

Important ecological processes the directly influence the health of chinook salmon or its habitat include:

- Central Valley streamflows,
- Coarse sediment supply,
- Stream meander,
- Floodplain and flood processes,
- Stream temperatures,
- Bay-Delta hydraulics, and
- Bay-Delta aquatic foodweb.

Habitats used by chinook salmon during their juvenile or adult life stages include:

- Tidal perennial aquatic habitat,
- Delta sloughs,
- Midchannel islands and shoals,
- Freshwater and essential fish habitats,
- Saline and fresh emergent wetlands, and
- Riparian and riverine aquatic habitats.

Stressors that adversely affect chinook salmon or its habitats include:

- Water diversions,
- Dams and other structures,
- Levees, bridges, and bank protection,
- Dredging and sediment disposal,
- Gravel mining,
- Predation and competition,
- Contaminants,
- Harvest,
- Some aspects of artificial propagation programs, and
- Disturbance.

OBJECTIVES, TARGETS, ACTIONS, AND MEASURES

WINTER-RUN CHINOOK SALMON

The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay and Suisun Marsh.

SPECIES TARGET: The mean annual spawning abundance over any 13 consecutive years will be 10,000 females. The geometric mean of the Cohort Replacement Rate over those same 13 years will be greater than 1.0. Estimates of these criteria will be based on natural production alone and will not include hatchery-produced fish. If the precision for estimating spawning run abundance has a standard error greater than 25%, then the sampling period over which the geometric mean of the Cohort Replacement Rate is estimated will be increased by 1 additional year for each 10% of additional error over 25%.

LONG-TERM OBJECTIVE: Create self-sustaining populations of winter-run chinook salmon in both the mainstem Sacramento River and in Battle Creek at abundance levels equal to or greater than those identified in the proposed Recovery Plan for Sacramento River Winter-run Chinook Salmon (National Marine Fisheries Service 1997).

SHORT-TERM OBJECTIVE: Achieve recovery as defined in the NMFS proposed Recovery Plan for Sacramento River Winter-run Chinook Salmon.

RATIONALE: Winter-run chinook salmon are unique to the Sacramento River and are adapted to

RATIONALE: Winter-run chinook salmon are unique to the Sacramento River and are adapted to spawn in the cold, spring-fed rivers now located above Shasta Dam. They are presently maintained in artificial cold-water habitat below Keswick Dam in the Sacramento River and in a special hatchery program. Because they are so vulnerable to disasters (e.g., a toxic spill from Iron Mountain mine, just upstream), at least one other naturally reproducing population needs to be established to reduce the probability of extinction. Battle Creek, a cold-water stream to which winter-run chinook have been deliberately denied access in the past, is the best and probably only site available for such restoration. It is unlikely, however, that winter-run chinook salmon will ever be much more abundant than specified in the recovery plan goals because available habitat is so limited.

STAGE 1 EXPECTATIONS: The cohort replacement rate (the number of future spawners produced by each spawner) in 7-10 years should continue to exceed 1.7 (as it has in recent years), and average abundance should increase. Battle Creek restoration should have proceeded to a point where a determination can be made regarding the benefits of re-introducing winter-run chinook. The determination will be based on genetic considerations. The probability of extinction of winter-run chinook will have been recalculated using assumptions regarding the establishment of an additional self-sustaining winter-run chinook population.

SPRING-RUN CHINOOK SALMON

> The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh.

SPECIES TARGETS: The Central Valley spring-run chinook salmon Evolutionarily Significant Unit (ESU) will be regarded as restored when the ESU meets specific viability criteria to be established in the NMFS recovery plan for Central Valley salmonids. Viability of the Central Valley spring-run ESU will be assessed according to the "Viable Salmonid Populations" (VSP) framework developed by the NMFS (in review). The framework deals with four population characteristics:

1. ABUNDANCE: populations are large enough to resist extinction due to random environmental, demographic and genetic variation.

2. PRODUCTIVITY: populations have enough reproductive capacity to ensure resistance to episodes of poor freshwater or ocean conditions and the ability to rebound rapidly during favorable periods, without the aid of artificial propagation.

3. SPATIAL DISTRIBUTION: populations are distributed widely and with sufficient connectivity such that catastrophic events do not deplete all populations and stronger populations can rescue depleted populations.

4. DIVERSITY: populations have enough genetic and life history diversity to enable adaptation to long-term changes in the environment. Populations achieve sufficient expression of historic life history strategies (migration timing, spawning distribution), are not negatively impacted by outbreeding depression resulting from straying of domesticated hatchery fish, and are not negatively impacted by inbreeding depression due to small population size and inadequate connectivity between populations.

The NMFS recovery planning for Central Valley salmonids will proceed in two phases. The first phase will be conducted by a technical recovery team (TRT) that will produce numeric recovery criteria for populations and the ESU following the VSP framework, factors for decline, early actions for recovery, and provide plans for monitoring and evaluation. The TRT will review existing salmonid population recovery goals and management programs being implemented by federal and State agencies and will coordinate with agency scientists, CALFED staff and Central Valley science/restoration teams such as the Interagency Ecological Program work teams during this first phase. TRT products will be peer-reviewed and made available for public comment.

The second phase will be identification of recovery measures and estimates of cost and time required to achieve recovery. The second phase will involve participation by agency and CALFED staff as well as involvement by a broad range of stakeholders, including local and private entities, with the TRT providing technical guidance on biological issues.

LONG-TERM OBJECTIVE: Restore wild, naturally reproducing populations of spring-run chinook salmon to numbers or spawning densities in the Sacramento River system equal to those that existed in the 1940s, as measured over a period of at least 25 years.

SHORT-TERM OBJECTIVE: Develop and implement a recovery plan and achieve recovery levels.

RATIONALE: Spring-run chinook salmon were historically the most abundant run of salmon in central California. Unfortunately, they spawned primarily in stream reaches that are now above major dams. The biggest declines in their abundance occurred after Shasta and Friant dams were built (1944 and 1942, respectively). A run of 50,000 spring-run chinook salmon alone was stranded when Friant Dam shut off San Joaquin River flows. Attempts to rear spring-run chinook salmon in hatcheries have largely failed, and both hatchery and wild populations in the Sacramento River proper are hybridized with fall-run chinook. The only streams maintaining small runs of wild, unhybridized spring-run chinook salmon are Deer, Mill, Butte and Big Chico Creeks. Spring-run chinook have been listed as threatened by the California Fish and Game Commission (September 1998) and were federally listed as endangered in 1999. It is uncertain whether additional subpopulations can be reestablished in other Sacramento River basin streams or in the San Joaquin River basin, but the possibilities need to be investigated. If establishing additional subpopulations is impossible, the long-term objective may have to be modified downward.

STAGE 1 EXPECTATIONS: Better methods for estimating population sizes should be developed. Populations in Deer, Mill, and Butte creeks should not fall below numbers found in the streams in 1990-1998, with a cohort replacement rate greater than 1. Factors limiting survival of out-migrating smolts should be determined. The ability of Big Chico Creek to sustain a spring-run chinook population should be evaluated and measures taken to improve its capacity to support salmon. The potential for other streams, including Battle Creek, to support runs of spring-run chinook salmon should be evaluated. The potential for using artificial propagation as a tool to expedite reintroduction to former habitat will have been evaluated and, if deemed appropriate by the resource agencies, a propagation program should be implemented.

LATE-FALL-RUN CHINOOK SALMON

The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh.

SPECIES TARGETS: Achieve species recovery by 1) increasing the number of wild spawning fish in the Sacramento River to a mean number of 22,000 fish and maintain the population such that it does not drip below 15,000 fish for 15 years, 3 of which are dry or critical and 2) achieving juvenile survival rates that approach pre-CVP and SWP levels following years when the adult populations are fewer that 15,000 fish in the Sacramento River (U.S. Fish and Wildlife Service 1996).

Note: The Central Valley fall/late fall-run ESU is a candidate species, not a threatened or endangered species, under the ESA. The NMFS recovery plan for Central Valley salmonids will therefore not include formal recovery goals for populations in this ESU. The recovery plan for Central Valley salmonids will identify factors of concern and measures to ensure the long-term conservation of the Central Valley fall/late fall-run ESU and recovery actions proposed for listed ESUs will be evaluated to ensure that they do not place non-listed species at significant risk. CALFED, DFG and the NMFS will work together to identify restoration goals following the VSP framework in a process separate from the NMFS recovery planning process. These goals will aim to ensure the long-term viability of Sacramento and San Joaquin fall-run and Sacramento late fall-run chinook salmon.

LONG-TERM OBJECTIVE: Restore wild, naturally reproducing populations of late-fall-run chinook salmon to numbers or spawning densities in the Sacramento River equal to those that existed in 1967-1976, as measured over a period of at least 25 years, and reestablish a self-sustaining population in the San Joaquin River drainage.

SHORT-TERM OBJECTIVE: Develop and implement a recovery plan and achieve recovery levels.

RATIONALE: Late-fall-run chinook salmon have long been recognized as a distinct run in the Sacramento River and, formerly, in the San Joaquin River. Their numbers in the Sacramento River were not quantified until Red Bluff Diversion Dam was completed in 1967. The dam was a major factor contributing to their most recent decline. The NMFS does not distinguish late-fall-run from fall-run chinook salmon in its listing proposal (National Marine Fisheries Service, 1998), but the two forms represent distinct life history patterns in the Sacramento River and therefore need to be managed separately. Late-fall-run chinook were mainstem spawners and probably were separated from their principal spawning grounds by Shasta and Friant dams. Restoration may be possible in rivers that have had their flow regimes adjusted to accommodate the oversummering of juveniles (e.g., Tuolumne River).

STAGE 1 EXPECTATIONS: Late-fall-run chinook salmon numbers should not fall lower than they have been in the 1990s. Factors limiting their abundance should be determined, and methods to determine their abundance should be developed.

FALL-RUN CHINOOK SALMON

> The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh.

SPECIES TARGETS:

SAN JOAQUIN FALL RUN: Achieve species recovery by 1) increasing the number of naturally spawning fish in the Stanislaus, Tuolumne, and Merced rivers to a median number of 20,000 fish and maintaining a three-year running average that does not drop below 3,000 fish for 15 years, three of which are dry and critical and 2) achieving smolt survival rates that approach pre-CVP and SWP levels when adult numbers decline to fewer that 3,000 natural spawning fish.

SACRAMENTO FALL RUN: Restore self-sustaining populations to all their native streams.

NOTE: The Central Valley fall/late fall-run ESU is a candidate species, not a threatened or endangered species, under the ESA. The NMFS recovery plan for Central Valley salmonids will therefore not include formal recovery goals for populations in this ESU. The recovery plan for Central Valley salmonids will identify factors of concern and measures to ensure the long-term conservation of the Central Valley fall/late fall-run ESU and recovery actions proposed for listed ESUs will be evaluated to ensure that they do not place non-listed species at significant risk. CALFED, DFG and the NMFS will work together to identify restoration goals following the VSP framework in a process separate from the NMFS recovery planning process. These goals will aim to ensure the long-term viability of Sacramento and San Joaquin fall-run and Sacramento late fall-run chinook salmon.

LONG-TERM OBJECTIVE: Restore self-sustaining populations of fall-run chinook salmon to all their native streams, except those above Shasta Reservoir.

SHORT-TERM OBJECTIVE: Recover San Joaquin fall-run chinook salmon to levels identified in the Delta Native Fishes Recovery Plan, and in the Sacramento River, have wild salmon spawners number 75,000-100,000 fish each year, assuming that salmon of wild origin make up 50% of the fall run.

RATIONALE: When Shasta and Friant dams were built, implicit promises were made that fisheries for salmon would not decline. It was assumed that hatcheries and habitat improvements would make up for any losses caused by the dams. The hatchery system has been at best a partial success even though it has focused heavily on fall-run chinook salmon. Because of the hatcheries, the status of wild populations in the Central Valley is uncertain, and concerns exist about genetic and other effects of hatchery programs on the wild-spawning stocks.

Much of the habitat previously available for wild-spawning fish is permanently disconnected from the migration corridors. However, the remaining habitat or the "new" habitat in the tailwaters of large dams should be usable for spawning at densities (fish per unit of habitat, either area or distance) as great as those that existed before the construction of Shasta, Friant, and other dams. The objective, therefore, is to restore the spawning densities of fall-run chinook salmon to values existing before Shasta and Friant Dams were built. The restoration of salmon to pre-dam densities using primarily currently available habitat depends on assumptions about habitat quality and the biology of the fish that need to be tested.

STAGE 1 EXPECTATIONS: Numbers of wild fall-run chinook salmon should not fall lower than they have been in the 1990s. Factors limiting their abundance in each major river should be determined, including the impact of hatchery fish. Programs (e.g., mass marking of hatchery juveniles) should be instituted to allow hatchery fish to be distinguished from wild fish, and surveys should be made to determine the contribution of hatchery fish to natural spawning.

RESTORATION ACTIONS

The overall target for chinook salmon is presented as a strategy to increase the survival and return of each generation. ERP's approach is to contribute to managing and restoring each stock with the goal of maintaining cohort replacement rates of much greater than 1.0 while the individual stocks are rebuilding to desired levels. When the stocks approach the desired population goals, ERP will contribute to maintaining a cohort replacement rate of 1.0. In practical application, management and restoration goals need to be developed on a stream-specific basis and include all runs of chinook salmon.

The strategy for achieving the chinook salmon vision includes protecting existing populations, restoring ecological processes, improving habitats, and reducing stressors. The following actions would improve chinook salmon populations:

- Restore ecological processes in the Central Valley. Chinook salmon are dependent on adequate streamflows; gravel recruitment, transport, and cleansing; low water temperatures; and channel configurations.
- Maintain adequate streamflows to improve gravel recruitment, transport, and cleansing; water temperatures; and channel conditions. Improved streamflow would also provide attraction flows for adult salmon migrating upstream to spawning grounds through the Bay, Delta, and lower rivers. Flows also support downstream transport for juvenile salmon migrating to the ocean and minimize losses to diversions and predators. Short-term improvements in flows may be possible with existing supplies. Necessary changes in streamflows may require long-term water supply improvements.
- Restore habitats required by chinook salmon. Where ecological processes cannot restore habitats to the desired level, habitats can be improved using direct measures. Important habitat components for chinook salmon include spawning gravel, water temperatures, and access to spawning habitats. In the short term, gravel can be introduced to rivers where needed. Fish passage facilities can be upgraded where deficient. Generally, habitat quality and availability along the lower reaches of the major rivers and in the Delta have been greatly diminished by the construction of levees; construction of levees that isolated rivers from their floodplains; and removal or other loss of riparian, shaded riverine, and woody debris habitats. A major long-term commitment will be required to restore the habitats in these areas.
- Protect existing populations in the Central Valley. The ERP focuses on supporting efforts to protect existing natural populations of chinook salmon by limiting harvest of naturally spawned fish while emphasizing the harvest of hatchery-produced fish. A short-term action would be to evaluate mass marking of all hatchery-produced chinook salmon and limiting harvest to only marked salmon. Another short-term action would be to promote hatchery practices that embody the concepts of genetic conservation.
- Eliminate stressors that cause direct or indirect mortality of chinook salmon. Important stressors on chinook salmon include insufficient streamflow, high water temperatures, blockages at diversion dams, predation near human-constructed structures, contaminants, unscreened diversions, and harvest. ERP focuses on reducing each of these stressors in the short term and

eliminating the conditions that bring about the stress factors in the long term by restoring natural processes and eliminating stressors where feasible.

MSCS CONSERVATION MEASURES

The following conservation measures were included in the Multi-Species Conservation Strategy (2000) to provide additional detail to ERP actions that would help achieve chinook salmon habitat or population targets.

- Coordinate protection, enhancement, and restoration of occupied and historic chinook salmon habitats with other federal, state, and regional programs (e.g., the San Francisco Bay Area Wetlands Ecosystem Goals Project, the Anadromous Fish Restoration Program, the U.S. Fish and Wildlife Service recovery plans, the SB 1986 program, and the Corps' Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historic habitat use areas to avoid potential conflicts among management objectives and identify opportunities for achieving multiple management objectives.
- Implement management measures identified in the proposed recovery plan for the Sacramento River winter-run chinook salmon.
- Implement applicable management measures identified in the restoration plan for the Anadromous Fish Restoration Program and the recovery plan for the native fishes of the Sacramento/San Joaquin Delta.
- Operate hatcheries such that the maintenance, and expansion of natural populations are not threatened by the release of hatchery fish.
- Manage operations at the Red Bluff diversion dam to improve fish passage, reduce the level of predation on juvenile fish, and increase fish survival.
- To the extent consistent with CALFED objectives, manage export flows from the San Joaquin River to improve conditions for upstream migration of adult fish (i.e., attraction flows).
- To the extent consistent with CALFED objectives, operate physical barriers in the Delta in a manner to assist in achieving recovery goals.
- Continue research to determine causes for low outmigration survival of fish from the San Joaquin River in the south Delta and identify and implement measures to improve outmigration survival.

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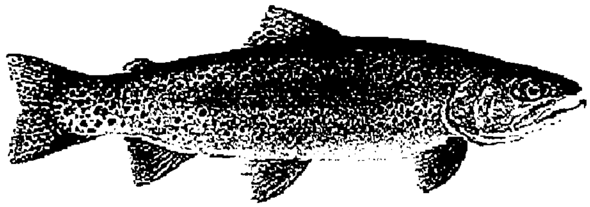


INTRODUCTION

Steelhead trout are an anadromous form of rainbow trout. This species spawns in freshwater, and its juveniles rear in cool water for a year or more before migrating to the ocean. Steelhead spend one to three years in the ocean before maturing and returning to freshwater to spawn. While they rear in fresh water, young steelhead are susceptible to mortality resulting from elevated water temperatures and a variety of other adverse environmental and habitat factors.

Steelhead is one of the listed species for which actions are developed to achieve its recovery.

The California Fish and Wildlife Plan estimated that there were 40,000 adult steelhead in the Central Valley drainages in the late 1950s, and Hallock et al. (1961) estimated that the average annual steelhead run size was 20,540 adults in the Sacramento River system above the mouth of the Feather River. In the early 1960s, It is estimated that 30,000 adult steelhead returned to Central Valley rivers and streams (Mills et al. 1996, Mills and Fisher 1994).

In the early 1990s, the total (hatchery and wild) annual run size for the entire system was roughly estimated to be no greater than 10,000 adult fish (McEwan and Jackson 1996). A more reliable indicator of the magnitude of the decline of Central Valley hatchery and wild stocks is the trend reflected in the Red Bluff Diversion Dam (RBDD) counts: numbers declined from an average annual count of 11,187 adults for the ten-year period beginning in 1967, to 2,202 adults annually in the early 1990s. The average escapement estimates for wild (natural spawners) above RBDD for the same time periods was 6,819 and 893, respectively (McEwan and Jackson 1996).

Hallock et al. (1961) reported that the composition of naturally produced steelhead in the population estimates for the 1953-54 through 1958-59 seasons averaged 88%. This is probably not reflective of present composition in the Central Valley system, due to the large-scale loss of spawning and rearing habitat and increases in hatchery production. During the time period of the Hallock et al. study, only Coleman and Nimbus hatcheries were in operation. Today, four Central Valley steelhead hatcheries (Mokelumne River, Feather River, Coleman and Nimbus hatcheries) collectively produce approximately 1.5 million steelhead yearlings annually.

Historically, steelhead ranged throughout the Sacramento River system (including both east- and west-side tributaries) and the San Joaquin River system. Historical documentation exists that show steelhead to have been widespread throughout the San Joaquin River system, At present, naturally spawning populations of steelhead are known to occur in the upper Sacramento River and tributaries, Mill, Deer, and Butte creeks, and the Feather, Yuba, American, and Stanislaus rivers. However, the presence of naturally spawning populations appears to correlate well with the presence of fish monitoring programs, and recent implementation of monitoring programs has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

RESOURCE DESCRIPTION

Rainbow trout exhibit one of the most complex life histories of any salmonid species. Those that exhibit anadromy (i.e., migrate as juveniles from fresh water to the ocean and then return to spawn in fresh water as adults) are called steelhead. Rainbow trout populations appear to be structured around several key life-history traits and a continuum of migratory behaviors, the two extremes being anadromy (strongly migratory) and residency (non-migratory). Within these extremes are potamodromous (river migratory), and possibly estuarine and coastal forms. All of the life-history forms within a particular stream comprise a single, interbreeding population.

This complexity of life history forms can also be found in individual behaviors. A rainbow trout can mature in fresh water and spawn, then migrate to the ocean and return to spawn in subsequent years as a steelhead. More importantly, there is evidence that progeny can exhibit a different life-history strategy than that of their parents (e.g., offspring of steelhead can adopt a resident lifestyle and the offspring of resident trout can migrate to the ocean and become steelhead) (IEP Steelhead Project Work Team 1999).

A complex structure and flexibility in reproductive strategies among a single population may be necessary for the long-term persistence of the population in environments that are frequently suboptimal and not conducive to consistent, annual recruitment of migrants to the ocean. It was not uncommon, even under unimpaired conditions, for the lower reaches of many Central Valley streams to become intermittent during the dry season (and longer), isolating individuals in the perennial headwaters, and these conditions may have persisted for years.

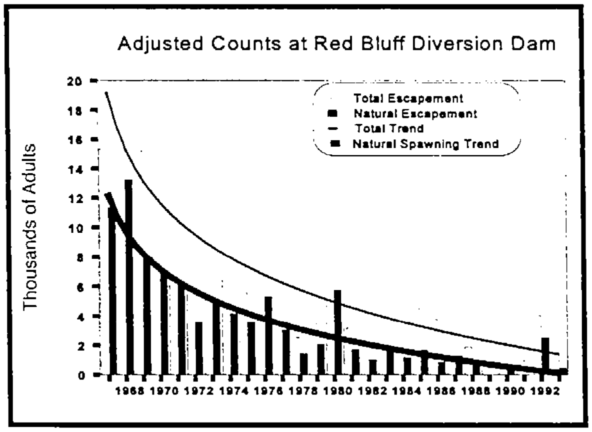
Having several different life-history strategies among a single population effects "bet-hedging" against extinction. If ecological conditions are not conducive for a particular life history form to survive and reproduce, the population would be sustained by other life history forms that could successfully reproduce (usually the resident fish). However, for this mechanism to be effective in sustaining the population, the ecological linkages between the various life-history forms, and the habitat linkages between the lower river reaches and the headwaters, must be maintained. The large-scale disruption of this linkage that has occurred in the Central Valley through the placement of impassable dams on many streams may go a long way in explaining the significant decline of Central Valley steelhead stocks.

Generally, juvenile steelhead typically migrate to ocean waters after spending 1-3 years in fresh water. Most Central Valley steelhead migrate to the ocean after spending two years in fresh water (Hallock et al. 1961). They reside in marine waters for typically 2 or 3 years before returning to their natal stream to spawn as 3- to 5-year-old fish. Unlike Pacific salmon, steelhead are iteroparous (i.e., they are capable of spawning more than once before they die). However, post-spawning survival rates are generally low, thus the percentage of adults in the population that spawn more than once is low.

Biologically, steelhead can be categorized into two reproductive ecotypes according to their state of sexual maturity at the time of river entry, the duration of their spawning migration, and behavior. These two ecotypes are termed *stream maturing* and *ocean maturing* (also known as *summer steelhead* and *winter steelhead*, respectively). Stream maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn. Ocean-maturing steelhead enter fresh water with well-developed gonads and spawn shortly thereafter. Central Valley steelhead stocks are of the ocean-maturing type and are called winter steelhead. Some evidence suggests that summer steelhead were once present but that construction of large dams on major tributaries, which would have blocked adults from reaching the deep pools they need to oversummer, most likely eliminated these populations.

The National Marine Fisheries Service (NMFS) has identified steelhead populations in the Central Valley as composing a single evolutionarily significant unit (ESU). ESUs are defined using a variety of physical and biological data, including the physical environment (geology, soil type, air temperature, precipitation, riverflow patterns, water temperature, and vegetation); biogeography (marine, estuarine, and freshwater fish distributions); life history traits (age at smolting, age at spawning, river entry timing, spawning timing); and genetic uniqueness.

The Central Valley steelhead ESU comprises the Sacramento River and its tributaries and the San Joaquin River and its tributaries downstream of the confluence with the Merced River (including the Merced River). Recent data from genetic studies show that samples of steelhead from Deer and Mill creeks, the Stanislaus River, Coleman National Fish Hatchery on Battle Creek, and Feather River Hatchery are well differentiated from all other samples of steelhead from California (Busby et al. 1996; NMFS 1997).



In reviewing the status of steelhead, NMFS (1996a) concluded that the Central Valley ESU is in danger of extinction due to the following:

- water diversion and extraction
- mining
- agriculture
- urbanization
- habitat blockages
- logging
- harvest
- hydropower development, and
- hatchery introgression.

Steelhead are somewhat unique in that they depend on essentially all habitats of a river system. Steelhead use the estuary for rearing and adapting to saltwater. The main channel is used for migrating between the ocean and upstream spawning and rearing areas. The tributaries are used for spawning and rearing. They are, therefore, found in virtually all ecological management zones and many of their respective ecological management units.

Overall, the decline of the steelhead trout population resulted from the cumulative effects of degrading habitats and environmental processes and functions. These factors include constructing dams on the larger rivers and streams which eliminated access to critical habitat for adults and juveniles; excessively warm water temperatures during the rearing period of juvenile steelhead; interrupting or blocking the free passage of juveniles and adults at diversion dams; loss of natural emigration cues due to altered flow regimes resulting from the export of water from large diversions in the south Delta; unscreened and poorly screened diversions which entrain fish as they are migrating; and channelization, levee construction, and land use which have led to degradation and loss of woody debris, shaded riverine aquatic, riparian corridors and forests, and floodplain functions and habitats. The single, most limiting factor for the decline of Central Valley steelhead is elimination of access to an estimated 82% to 95% of historical spawning and rearing habitat (Reynolds et al. 1993; Yoshiyama et al. 1996).

A host of other factors has also contributed to the decline of the steelhead trout, but perhaps to a lesser degree. These include the various smaller water diversion facilities and dams; extensive loss of rearing habitats in the lower Sacramento River, San Joaquin River, and Sacramento-San Joaquin estuary through levee construction and marshland reclamation; and the interaction with and predation by non-native species.

VISION

The vision for Central Valley steelhead trout is to recover this species listed as threatened under the ESA and achieve naturally spawning populations of sufficient size to support inland recreational fishing and that fully use existing and restored habitat areas.

Achieving this vision will primarily require restoring degraded spawning and rearing habitats and enhancing fish passage to historical habitat. Reestablishing the ecological linkage between headwaters and lower reaches by restoring steelhead access to historical habitats above dams is the most important element to achieve the vision.

This vision is consistent with restoring populations of steelhead to levels that eliminate the need for any future protection under the State and federal Endangered Species Acts (ESAs). To achieve this vision, ecological functions and processes that create and sustain steelhead habitats would be maintained and restored and stressors and known sources of mortality would be reduced or eliminated.

The strategy for attaining this vision is to restore degraded spawning and rearing habitat in tributaries; restore access to historical habitat that is partially or completely blocked; dedicate more water in storage to provide adequate tailwater habitat conditions (primarily water temperature) year-round below